



557261

---

# **Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials**

**M.Lansing and T. Lawrence  
NASA Marshall Space Flight Center**



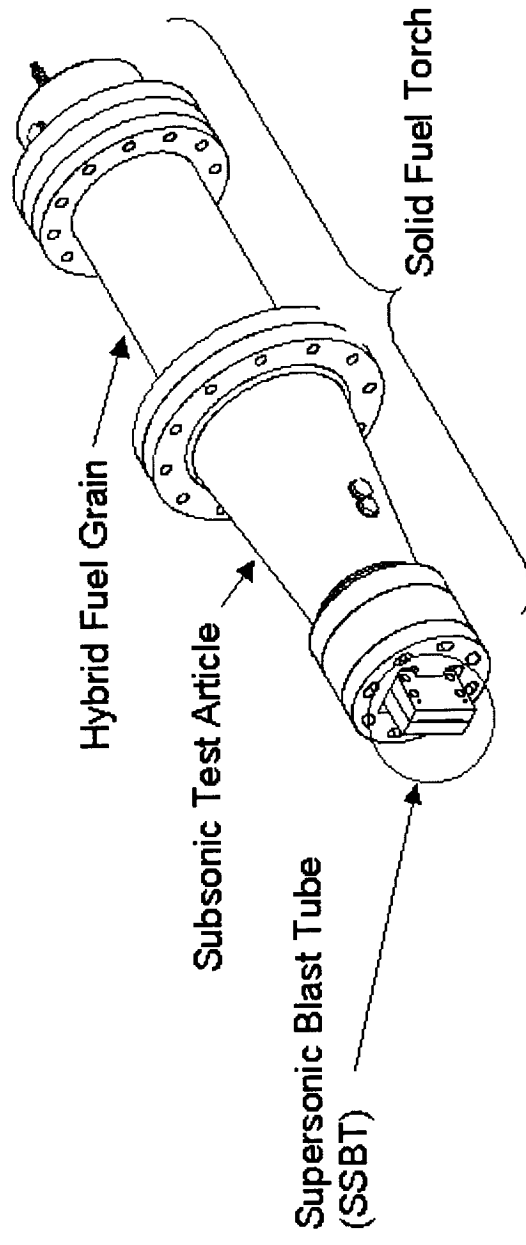
## **Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials**



- IDENTIFICATION OF NEED FOR NEW TEST BED
  - Observation of Ply Lifting in motors
  - Plasma Torch provided low cost testing
    - Small heating area
  - Thiokol Seventy Pound Charge test motor induced Ply Lift in test sections
  - New low cost test bed needed for Ply Lift testing
    - Solid Fuel Torch (SFT) development began with Thiokol



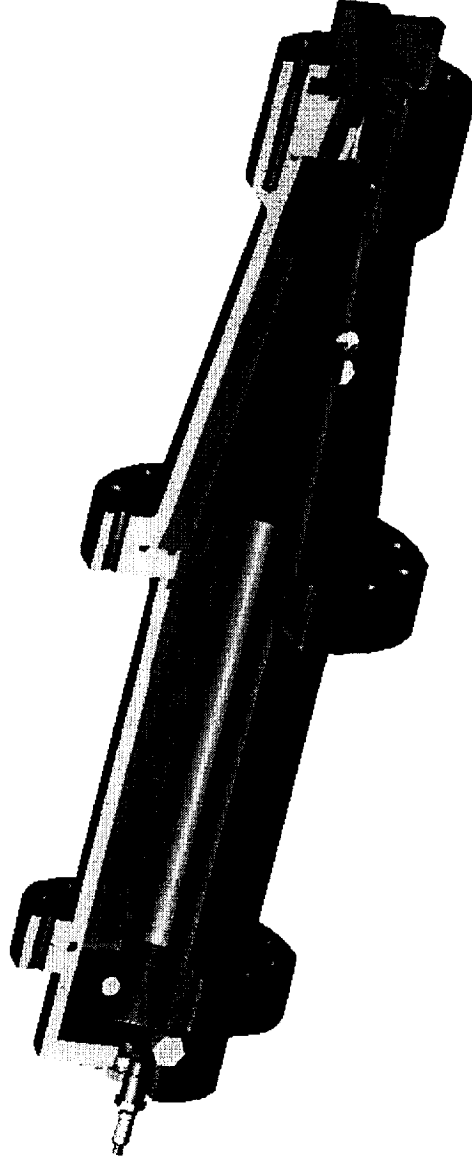
## Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials



## SOLID FUEL TORCH COMPONENTS



# **Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials**



**SOLID FUEL TORCH CUT-AWAY**



# Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials



SOLID FUEL TORCH TEST



## **Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials**



- **DEVELOPMENT EVOLVED ADDITIONAL USES**
  - Ply Lift issue overtaken by other/higher priorities
  - Maturing SFT used to evaluate several joint issues for RSRM
    - Nozzle to Case Joint polysulfide gas paths
    - Throat to Forward Exit Cone Joint study of void volumes and o-ring burning
  - Identified need for supersonic test with particle impingement
    - Operating parameters of SFT already characterized



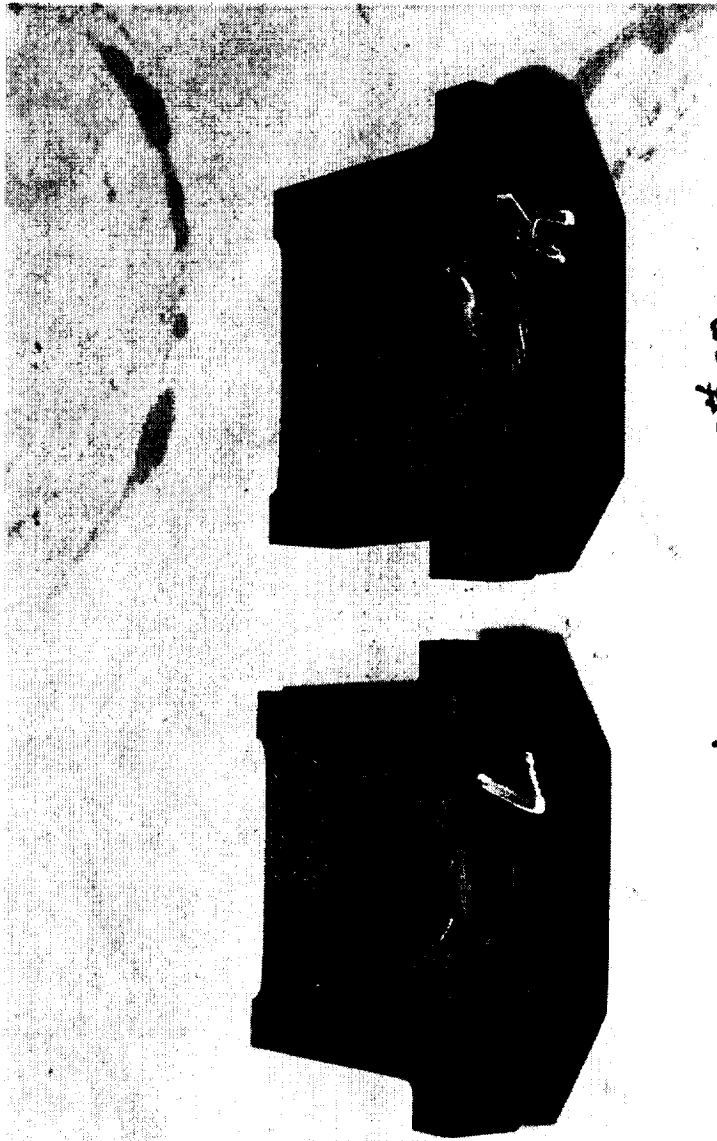
## **Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials**



- DEVELOPMENT OF SUPERSONIC BLAST TUBE (SSBT)
  - NASA and Thiokol performed iterative design for expansion/contraction of SSBT contours
  - Demonstrated performance with 0%, 18%, and 36% Al
    - Low  $C^*$  Efficiency at 36% Al
    - Subsequent testing at 26% Al resulted in unacceptable pressure fluctuations
    - Accepted 18% Al as standard
  - Demonstrated particle impingement capability for material discrimination



# Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials



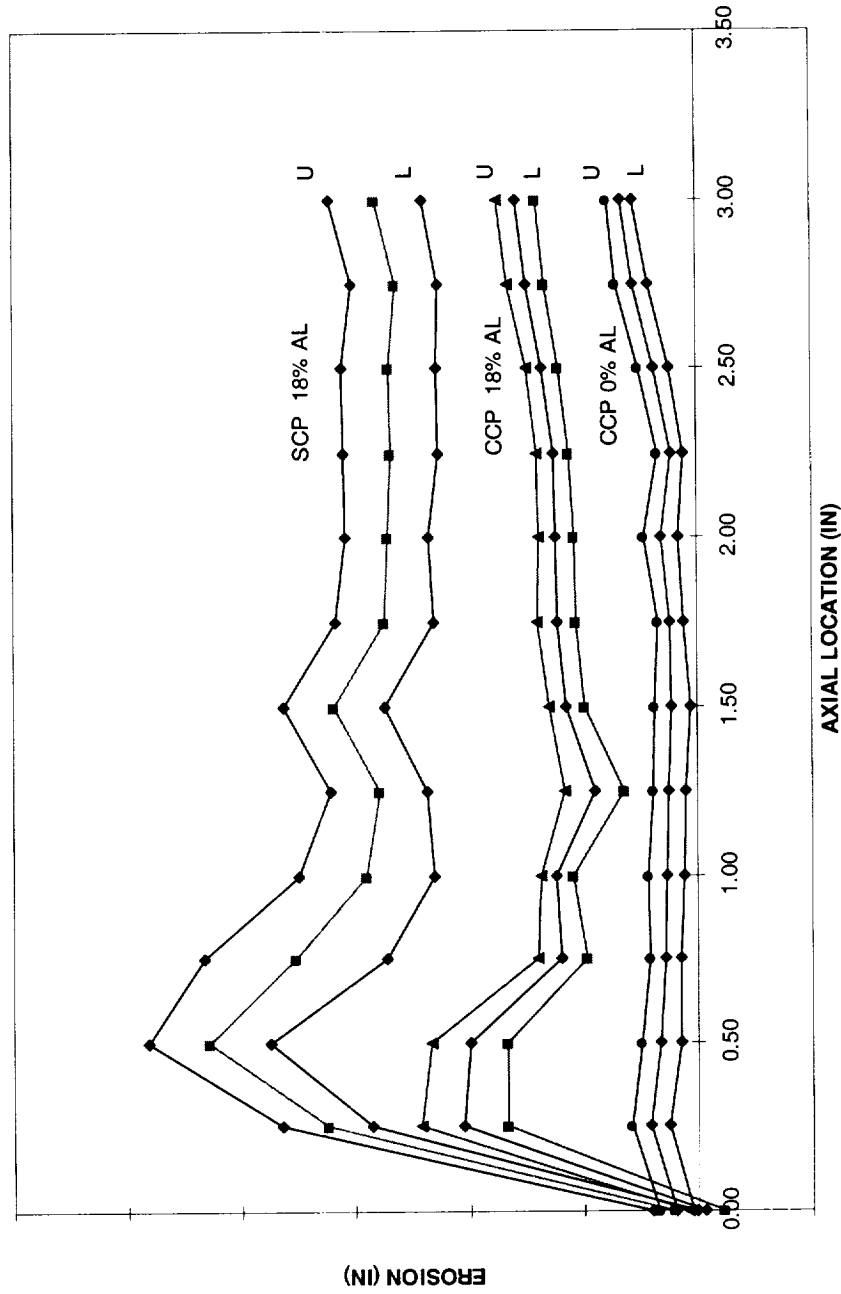
SFT #125 SSBT #52  
11/3/00

SUPERSONIC BLAST TUBE (SSBT)





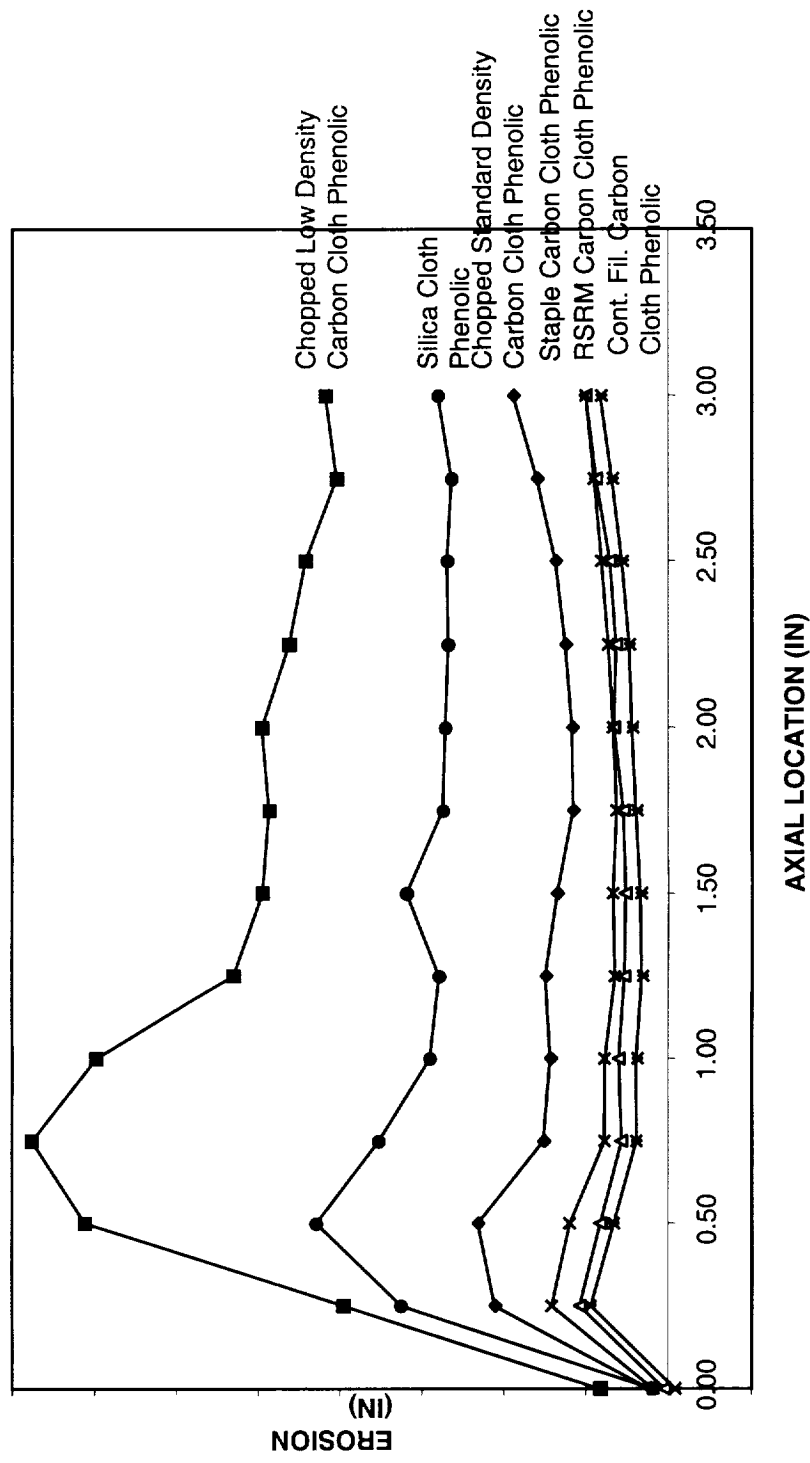
# Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials



PARTICLE IMPINGEMENT MATERIAL DISCRIMINATION



# Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials



## PARTICLE IMPINGEMENT MATERIAL DISCRIMINATION



## **Development of a Low-Cost, Subscale Test System to Evaluate Particle Impingement Erosion in Nozzle Ablative Materials**



- CURRENT STATUS
  - Solid Fuel Torch developed as low cost materials test bed
  - Standard operating parameters characterized
  - Supersonic Blast Tube developed for evaluating particle impingement sensitivity of materials
  - SFT/SSBT testing implemented in Rayon Replacement program for candidate screening